Reaction Paper

Shiv Raj Pant*
School of Electrical Engineering and Computer Science
Washington State University
Pullman, WA
Email: *shiv.pant@wsu.edu

I. Introduction

In this reaction paper, we will review and summarize two papers related to analysis of weighted signed social networks. The papers being reviewed are: [1] and [2]. In section II, we provide brief summary of the papers. In section III, we provide a critical discussion about strengths, weaknesses and limitations of the two papers. Finally, we discuss the future research directions mentioned in the papers as well as those arisen from our own insight.

II. Summary

A. Summary of [1]

The authors of [1] analyze the preferential attachment phenomenon (also known as "richer get richer") in the bitcoin transaction network where nodes represent users and edges represent transactions among users. This networks also includes the user review ratings of the transaction representated by the weights of edges. The study is motivated by the fact that user ratings play an important role in the e-commerce where it is not possible for a user to validate any product before purchase. The authors state that Ecommerce depends largly on trust and reputation of merchant and reviews are primary means of gaining trust.

The datasets chosen for the study are from popular bitcoin marketplaces- BITCOIN ALPHA and BITCOIN OTC. BITCOIN ALPHA is an online marketplace where anonymous users (vendors and customers) conduct transactions via the BITCOIN cryptocurrency. The transactions may involve exchange of bitcoins for cash as well as buying and selling of products. Customers rate their transactions with rating levels ranging from -10 to 10. The continuous transactions with ratings give rise to a network that is continuously evolving directed wighted trust network. The authors have also generated a synthetic network model with rating attributes. BITCOIN ALPHA is used as the basis of modelling and analysis wheras BITCOIN OTC is used to verify the synthetic model of the network. By analyzing preferential attachment phenomenon, the authors expect that the rating of nodes with high average should increase to maximum value 10 as the network evolves whereas the nodes with low average rating would drop to minimum value -10. However, contrary to above expectations, the actual results obtained are interesting where the user ratings converge to value approximately 2. The methodology used for the analysis is basically temporal network analysis, in which evolution of the network is recorded between Nov 2010 to Jan 2016. In addition to analyzing overall network, the authors have temporally analyzed by tracking a few users.To get preferential attachment, the authors have focussed on weighted in-degree and average rating. Their major findings can be summarized as follows:

- Ratings tend to be highest among small networks of presumably friendships whereas, users outside of those groups tend get lower rating
- Despite the outliers, the majority of most-rated users exhibit the preferential attachment (richer get richer) phenomenon
- The maximum and minimum ratings are found in users with few ratings. As a user performs transaction outside the closed group, the rating converges to approximately two. The overall temporal results show the preferential attachment.
- The rating distributions from synthetic network model show that the users of higher frequency of ratings converge to an average value of 2.

The paper is fully relevant to the course because it is devoted to analyzing the weighted signed social networks. The methodology is entirely based on the network analysis. The aurthors have used networks tools such as networkx to analyze the networks. The results and findings are drawn from real-world networks and useful to a varitey of other networks.

B. Summary of [2]

This paper proposes a solution to the problem of predicting weights of the links in weighted signed networks using two novel measures "goodness" and "fairness" of node behaviour. The "goodness" metric measures how much a node liked or trusted by other nodes and the "fairness" metric measures how fairly the node rates other nodes' level of trust.

The methodololgy used for approaching the solution is provided as "Fairness-Goodness Algorithm (FGA)" which basically involves computation of fairness and goodness scores for each node in the network.

The six datasets used for the analysis and evaluation are:

- BitCoin OTC network
- Bitcoin ALPHA
- Wikepedia Request-for-Adminship
- Wikepedia editor network
- Epinion network

- Twitter India Election data

A series of experiments have been performed to evaluate the performance of various features for edge weight prediction viz. Leave-one-out, Leave N% out, and multiple rergression predictions. Results are found promising for the analyzed datasets. The fairness and goodness metrics almost always have the best predictive power when compared against several other algorithms in the literature.

It is quite obvious that the paper is relevant to our course. It deals with the analysis of real-world social networks with interesting results.

The two papers studied are connected in the sense that both deal with the special type of networks called "weighted signed social networks". Both papers have discussed interesting properties about these networks.

III. Critique

A. Paper [1]

Strengths: The authors have discovered interesting results from the analysis of the subject networks. A synthetic model of the network has been created to validate their results.The authors have provided direct applications of such synthetic models in numerical experimentation and simulation. Experimentation is performed rigorously with clear diagrams and plots.

Weaknesses: Despite providing a strong analysis, the paper suffers from some drawbacks and limitations. The synthetic model is created for networks like BITCOIN ALPHA. Hence it is questionable to be used for other types of networks. Furthermore, the model is validated against another similar network BITCOIN OTC. Validation against only one network has a threat of validity against other networks. The analysis fails to include experiments against a wide variety of datasets.

B. Paper [2]

Strengths: One of the strength of the paper is the introduction of two novel metrics applied to nodes of networks to solve the problem of predicting edge weight in weighted signed networks. The authors have mentioned many direct application of such solution with clear examples pertaining to real-life social networks. Furthermore, the solution has been validated against a wide variety of datasets. The approach is novel and rigourously worked out. Another strength is that the datasets and codes have been made publicly available so that any curious reader/researcher can reuse and validate the approach.

Weaknesses: The study suffers from some weaknesses as follows: The results show that the approach does not perform perfectly in all the datasets studied.e.g. the goodness measure alone performs poor in case of regression model and the authors fail to provide explannation for that behaviour. Another limitation is that the solution has been applied in social networks. All the networks taken for experiments are social networks. Due to lack of experiments with other varieties of datasets, it is not clear if this approach is applicable to other types of networks.

IV. Further Work

A. Paper [1]

The authors have suggested some possible future research directions such as 1) Developing mechanisms to capture preferential attachment by including probability of an edge with a node based on node ratings on the synthetic models. 2)Modelling temporal aspect to reect growth of network with time, and separately modeling in-degree and out-degree to reflect only nodes with positive rating able to rate other nodes.

Other promising line of research might be to leverage the capability of synthetic network models to fraud detection in social networks where nodes(users) may dishonestly provide wrong rating values for other nodes. This kind of analysis is particularly helpful in ecommerce and other areas where user ratings are extremely important. Furthermore, the synthetic model can be extended to make it robust.

B. Paper [2]

The study has analyzed and applied the solution for social networks. Future research may involve leaveraging the current solution to analyze and predict behaviours of other types of networks.

References

[1] E. H. Aw, R. Gera, K. Hicks, N. Koeppen, and C. Teska, "Analyzing preferential attachment in peer-to-peer bitcoin networks," in *2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM)*. IEEE, 2018, pp. 1242–1249.

[2] S. Kumar, F. Spezzano, V. Subrahmanian, and C. Faloutsos, "Edge weight prediction in weighted signed networks," in *2016 IEEE 16th International Conference on Data Mining (ICDM)*. IEEE, 2016, pp. 221–230.